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Advanced Framing

From the Editor . . .

The mere mention of regulations is enough to raise everyone's blood pressure a degree or two.

We tend to think that construction is the most regulated sector in society. At times it may seem so, but I am not sure this is the case. Perhaps regulation seems onerous because it directly affects our livelihood. I suspect other professions (doctors, lawyers, bankers, investment dealers, the food industry, etc) are equally regulated, but those regulations affect fewer people directly or to us seem more at a distance from them.

It is fair to be on top of the regulatory environment, and to keep a standing watch on developments. For example: How many regulations do we really need? How detailed do formal regulations have to be? Who sets them - especially now that the public sector is considered bad, and there is considerable offloading to the private sector?

Although there is always much talk about regulations, this year the talk has become much more serious in BC. The new legislative environment requires builders to be licensed, maintain mandatory third party insurance coverage for all new residential construction, and puts more direct personal responsibility on builders for a longer time. The consequences of these changes for all concerned are yet to be seen. I suspect that in the end, the regulations will enhance the credibility and stature of professional builders. It will require more careful management of construction activity, and curb the excesses of the part-timer "tail gate" contractors.

It is worth noting there are several kinds of regulations and standards. Some regulations are formal (e.g. building codes and technical standards), while others are informal - what is expected of the industry based on knowledge and practice at the time. Many laws have evolved slowly, and are only written down when an unusual situation forces a formal code. Codifying everything in the most minute detail is impossible. That is why informal standards - call them "industry standards" or expectations are so important.

However, the real issue may not be the nature of the regulations, how many there are, and who writes them, but what is the underlying intent behind the standards and regulations? After all, regulations all have good intentions - very few are self serving. They generally are developed or refined as a result of a specific breakdown in the system. We need to remember that each of us at some time or other has called for "a law against/for ...." The underlying intent for regulations and standards are to clarify performance expectations.

It is easy to dismiss new regulations as overkill when done in response to a problem that has sullied the industry in the past few years. Yet home purchasers have expectations for a certain level of performance. Does it have to be spelled out in detail? Do we really have to spell out that rain and water has to be kept out of a building in order to be considered as performing satisfactorily?

In the more litigious environment we are entering (the USA model, where everything is subject to court battles), maybe it has to written down!

Richard Kadulski,
Editor

solplan review

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Advanced Framing

Using Advanced Framing for efficient resource management

For a sustainable future we need to manage our resources better. To accomplish this, we must use resources more efficiently when building houses.

Conventional wood-frame design and construction has not changed greatly over the last 20 years. Material and labour waste is common. Often, much more material than necessary is used due to perceived increased structural rigidity, convenience or for assumed code compliance. The additional materials and labour may serve no purpose and add appreciably to the cost of a project.

For some time efforts have been made to promote ***Advanced Framing***, also known as Optimum Value Engineering (OVE). However, there are few manuals that describe advanced framing.

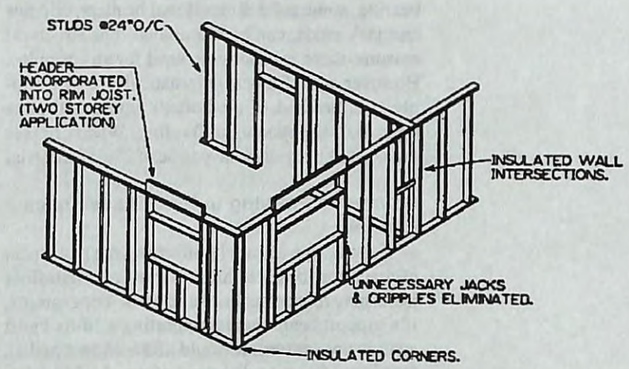
Because advanced framing is relatively new or seldom thought of, the average homebuilder will have to rethink some standard framing techniques. Advanced framing requires comparing alternative materials and methods to determine the least costly combination that will result in a structurally acceptable product. Many advanced framing techniques are now recognized in building codes, but builders should check with their local officials before using any new framing method or material.

Cost saving techniques should not be equated with low quality building. Advanced framing techniques offer economical and durable construction. We just need to recognize that traditional construction generally uses much more material and labour than may be required.

Framing trades need to understand why certain cost-saving techniques are feasible, and why the structural integrity of the finished product will not be sacrificed by the change. However, it is important to note that special wind, seismic or snow load conditions may require additional analysis and material, but this will be specific to a particular house design and location.

The techniques proposed offer the builder a shopping list approach to advanced framing. Any or all these techniques can be applied in most buildings.

Besides using less lumber, advanced framing will reduce call backs by not having the extra wood in the wall to cause drywall problems. Drywall problems are usually caused by the differential shrinkage of two different pieces of lumber nailed together.



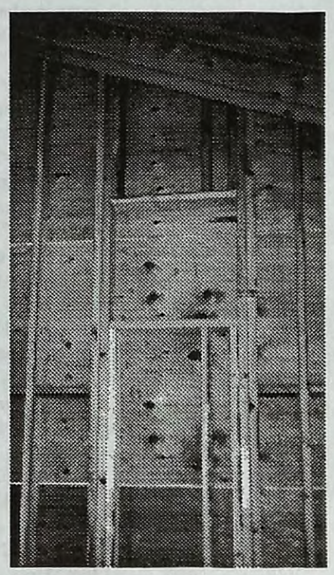
Designing and Planning for Advanced Framing

To have the greatest impact, consideration of advanced framing should begin at the planning stage. The most cost-effective spacing for structural members is 2 feet. The even dimensions simplify framing layout and use less material. In addition, more insulation can be added resulting in a more efficient and comfortable structure.

Regardless the spacing used, if all floor, wall, and roof framing is coordinated at the same spacing, the respective members bear directly over each other. Dead and live loads are thus transferred directly through the lower members to the foundation, resulting in a more efficient structure that might eliminate the need for some framing members.

Coordinating wall openings

Coordinating the openings in the wall to line up with the modular stud spacing on a least one side is highly recommended. This is not always pos-



Why is there so much framing in this 2x6 wall? Why double studs plus jacks for a 2x2 window when the wall does not even carry any roof load? Just calculate the cost of that extra lumber, and you can calculate how much money was wasted in this wall.

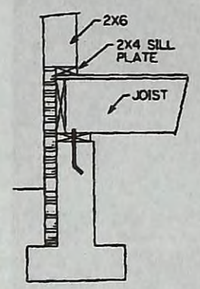
sible, but should be given consideration whenever possible.

Regardless of whether or not the walls are load-bearing, some solid dimensional headers, cripples and jack studs, can be eliminated. For structural reasons, there is usually no need for any cripples. However, most framers automatically place a cripple at either end of the bottom windowsill plate regardless the spacing of framing. When cripples are needed, they only have to be of 2" x 4" material

Advanced Framing in Floor Assemblies

Beams

If the design allows it, offsetting the placement of a support beam to allow for even length floor joists may reduce material and work. For example, if a support beam that is supporting a 26-foot joist span is not centred, it would allow 14 foot and 12 foot joists to be used instead of two 14 foot joists with 1 foot wasted at both ends. This of course assumes that there is no structural need for a larger joist with the offset.



Exterior Walls

Reducing the size of the bottom and top plate is a consideration for material reduction and energy efficiency. This works especially well with 2x6 wall construction. It is acceptable to use a 2x4 bottom plate under a 2x6 stud and cantilever the wall out 2". Once this is done 2 inches of foam insulation can be applied to the outside, over the rim joist or the foundation. This makes the outside wall flush and thermally protects the building envelope. However, be sure that it does not affect the structural integrity of the wall assembly.

Stud Spacing

The savings potential is significant when 24" spacing is used. Many builders today use 2x6 construction. Surprisingly, they use the same number of studs as in a conventional 2x4 wall even when this is not needed structurally. A 16" on centre module requires one extra stud for each 4 feet of wall which also requires more fasteners and labour to install.

A major concern is that the wider spacing will create drywall problems. This may have been a problem in the past when ⅜" drywall was used, but it is not a problem today with the quality of ½" and ⅝" materials available. There are fewer nail popping problems associated with the wider spacing.

With many exterior finishes available today, it is possible to eliminate wall sheathing altogether. However, it is necessary to use proper wind bracing to maintain structural integrity. One option is to recess a 1x piece of material laterally from the top plate to the bottom plate at a 45-degree angle. Another is to use a metal (T) shaped brace that is installed by cutting a kerf at an angle across several studs.

The primary function of non load-bearing partitions is simply to divide interior space and provide a desirable degree of privacy. Because structural requirements are small, the size of the framing members may be smaller and, if the 24" module is used, this will result in significant savings.

Openings in non load-bearing partitions such as passage doors and closets, have no particular structural requirements. Thus, the opening may be single-framed with one stud at each side and a block across the head. No header or jacks are required. Cripples are not required over the head. It is advisable to install blocking on either side of the opening using single studs. This will help eliminate the twisting that is likely to occur.

Door and Window Cripple and Jack Removal

Removing door and window cripples

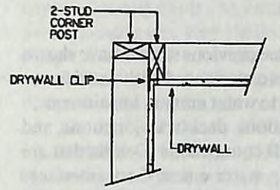
With proper planning a significant number of cripples and jacks could be removed. However, consult your engineer for specific applications.

Jacks are usually the easiest to eliminate because they generally do not support significant loads, especially below a window. They serve no purpose and occupy space that could be insulated. In addition, extra framing could cause drywall cracking or nail popping from differential shrinkage or movement. Even where they are required, jacks only need to be installed at the stud spacing used for framing.

Reduced Use of Backing and Two Stud Exterior Wall Corners

Reducing backing and using 2-stud exterior wall corners

A three stud corner is most commonly used in standard framing but is actually not necessary. The



Plan section

load on a corner stud is about one-half that of a regular stud, so two stud corners are more than adequate. The third stud typically serves as backing for the interior wall finish material, usually ½" thick drywall. However, the corner can be formed from the end studs in each of the two wall panels that meet in the corner. Drywall support is provided by one stud, and drywall clips are used for the other wall. Many types of drywall corner clips are available.

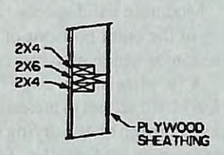
Eliminating the extra stud saves money and time. In addition, more insulation can be installed in the corner to reduce thermal bridging. This also reduces the potential of call backs to repair drywall because a floating joint has been created.

Eliminating Partition Posts

For the same reason as with a corner post, a "partition post" need not be built into the exterior wall for attachment of partitions. Except where the post is part of an engineered design, there is no structural requirement for anchorage of partitions to the exterior wall.

Reducing Built up Posts

In a 2x6 wall where a built up post is required to carry a three-lam beam in the floor above, typically a 3 - 2x6 post is used. However, 3 - 2x4 may be enough to carry the loads. This would save material and allow for insulation to be installed behind the post, thus increasing energy efficiency and reducing thermal bridging.



Plan section

Lintels

Coordinating Openings

Where possible, the location of door and window openings should be coordinated with the stud location on at least one side. Better yet, if possible, use window sizes that will fit between the studs so no added cripples or headers are required.

Removing and reducing lintel size

If a thorough analysis of the plans is done before construction begins, it may be determined that with some minor changes one could save on materials by placing lintels in alternate locations. Lintels can be eliminated in gable end walls where there is no load or where trusses are parallel to the wall in which the lintel is located. Other areas are where lintels can be eliminated are if windows are placed between studs in the wall and where ½" plywood is used as a sheathing, creating a box lintel.

It is also possible to move the lintel up above the top plate in a two-story design when used in conjunction with the rim joist, thus eliminating one ply from the header.

Forming Box Beams/Headers

A structural beam or header may also be formed by nailing and/or glue-nailing a plywood skin to framing members above the openings in a load-bearing wall. The advantages are that these use less material than conventional lumber headers and do not shrink. In addition, they can be insulated to the levels matching the rest of the wall.

At least one member must be continuous across the span. The vertical "stiffeners" should be spaced the same as the studs. In single skin applications the web can be installed to the inside or the outside with the face grain oriented horizontally. Due to code and liability considerations, box beams will likely require certification by an Engineer. ☼

As part of their waste management programs, the Greater Vancouver Regional District's Solid Waste and Recycling Department along with the Canadian Home Builders Association of B.C. sponsored the development of an Advanced Framing Techniques Seminar. Those attending receive a manual that describes advanced framing options, and an analysis of savings to be gained by following this approach.

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How Do Walls Dry?

The deterioration of wood framed walls in south-western British Columbia has attracted much attention. The fundamental reason for the problem is the inability of the exterior walls to manage rainwater. Although there is much information available on the behaviour of individual materials, there is little monitored data on the performance of actual assemblies. How well walls perform ultimately depends on limiting the wetting of wall components susceptible to deterioration, and enhancing the drying of these components when they do get wet.

Many problem walls are wood-framed and clad with face-sealed stucco. Face-sealed designs rely on the outside face of the cladding to prevent water ingress; they have no facility to manage or dissipate the moisture once water gets past this face. The alternative design strategy is the rainscreen approach.

The rainscreen is a design approach that limits the wetting of wall components. The City of Vancouver has now mandated rainscreen systems for all stucco clad buildings. However, the unresolved question still is: will a rainscreen enhance the drying of walls if they become wet?

A research project out by a consortium of public agencies and industry at the Forintek Laboratories in Vancouver will be testing several full size wall sections in a climate-controlled chamber. Until fully monitored data becomes available, we only have theoretical analyses. Even these provide valuable information that is not often enough taken advantage of.

A theoretical study to help understand the drying behaviour of stucco clad wall systems was done by Don Onysko. The main objective was to study ventilation cavity factors for stucco wall systems. Several wall details with stucco and other exterior siding materials were simulated with and without vented cavities. Walldry, a computer program developed by CMHC, was used.

The main detail affecting the rate of drying was noted to be the ventilation cavity behind the stucco. Whether it is stucco, wood, or vinyl siding, walls with no vented cavities dry slowly. In fact, vinyl siding appears to retain the moisture in the sheathing for a much longer time than many stucco walls. Wood siding applied directly to the building paper also has a poor drying capacity.

However, note that previous studies have shown that many problems experienced with wood frame walls can be traced to water entry at locations such as window penetrations, deck/wall junctions, and balcony railing/wall connections. Details that are effective at keeping water out at these interfaces have to be designed carefully. A drainage cavity alone will not prevent water entry into the stud cavity, nor will it provide a drying benefit. The performance of any design is ultimately dependent on how well it can be constructed.

Walls with vent cavities generally dry well, especially with both top and bottom of the vent cavity open. If the top vent of a vented stucco wall is closed, it slows drying significantly. However, even a gap as small as one mm should allow enough air movement to vent the cavity.

If the polyethylene vapour barrier is removed, simulations show a relatively rapid drying of the wall compared with the poly left in place. For a one time construction moisture load, this allows drying to take place into the interior if the final painting is not done until the moisture has escaped the wall cavity. However, chronic wetting of the wall is another matter entirely that has to be dealt with otherwise.

The controlling element for moisture flow in all of the calculations was the wood sheathing. Plywood sheathing has a higher permeability than OSB. This means that plywood sheathed walls probably dry more rapidly than OSB. However, the properties of the OSB can vary significantly form one manufacturer to another.

Moderate wind speeds resulted in greater cooling of the outer portions of the walls. This slowed the rate at which moisture could be lost by venting.

A preliminary experiment by Morrison Hershfield set out to measure the effect of drainage cavity design on the drying of capacity of insulated stucco-clad stud cavities. Seven wall samples, five wood framed and two steel framed, were tested. All were finished with stucco. Temperature and vapour pressure difference were controlled, but solar and wind effects were not simulated. (Drying may be enhanced by solar radiation and wind.)

A known quantity of water was put into the stud cavities, and the drying under controlled conditions was monitored for 5½ months. Four litres of water were added into the wood frame walls, at the rate of one litre per day. (2 litres at half a litre per day into the steel frame). Moisture movement within the specimens was very limited. From a practical perspective, where water enters a wall is where it stays and a small leak can lead to a local problem.

For the experiment, the "exterior" temperature was maintained between 5°C and 14°C, and the relative humidity between 45% and 85%. The "interior" temperature was maintained between 19°C and 25°C, with the RH ranging between 35% and 60%.

The drying process for all samples was very slow and took months to achieve any significant effect. The drying rate was not affected by cladding design, (either face sealed or rainscreen), nor by drainage cavity design. The drying rate will not be improved by the cladding type (stucco, vinyl siding, brick veneer, etc.)

The main benefit of the rainscreen is to resist rainwater penetration into the stud cavity. It provides a capillary break between the cladding, such as stucco, and the underlying components.

How effective is the drainage cavity? It depends on the moisture tolerance of the construction materials. Transient exposure to water is usually not a problem, even for wood materials, but continuous exposure to accumulated water can be a problem.☼

Stucco-Clad Wall Drying Experiment
by Morrison Hershfield Ltd and
Drying of Walls with Ventilated Stucco Cladding: A Parametric Analysis,
by: DMO Associates
for the Research Division, Canada Mortgage and Housing Corporation

Promoting Healthy Housing

The rapid growth in renovation work provides an opportunity to promote Healthy Housing. Heathy Housing is a move toward sustainability in the housing sector that enhances occupant health, energy and resource efficiency, environmental responsibility, and affordablilty.

Some Healthy Housing features have become, or are becoming, relatively common in renovations. These include high performance windows (double-glazed, low-E, argon fill), water conserving plumbing fixtures (driven primarily by Building Code requirements), low emission paints, alternatives to carpeting, and higher-than-code levels of roof insulation.

There are also other trends such as the increased use of engineered wood products, such as joists and trusses that, while driven by cost or convenience, also have associated Healthy Housing benefits.

On the other hand, awareness of many other Healthy Housing features is low among both the homeowners and renovation professionals. Some key opportunities that are commonly neglected include: whole-house ventilation; upgrading insulation in existing walls; fluorescent and task lighting; and low-emission materials for cabinets. In addition, resource efficiency (e.g., using products with lower material intensity, lower embodied energy, and/or recycled content) and environmental responsibility (e.g., avoiding products that impose environmental burdens during production) seldom factor into renovation decisions.

There is a relatively high level of homeowner interest in having at least some means of including Healthy Housing features. However, homeowners tend to have a little if any involvement in decisions relating to building systems. Because many small businesses are offering renovation services, influence over residential renovations is fragmented among many players, including financial institutions, architects, designers, builders, subtrades, suppliers, retail salespeople and building inspectors.

In one case, homeowners considered easy maintenance and comfort and selected a vinyl cushion flooring for their kitchen and bathrooms, so discounted wood flooring and ceramic tiles, but they were also trying to avoid strong chemicals whenever possible. They might have opted for other flooring options had they or their builder been aware of the emissions from vinyl cushion flooring and adhesives.

Homeowners usually feel they do not have the required level of knowledge to rationally engage in building systems decisions. These are then left to their renovating professionals, who serve as the main resource for information. As in the case of the decision to opt for the vinyl cushion flooring, a renovation professional can also be unfamiliar with Healthy Housing opportunities.

A recent CMHC study found that homeowners were impressed when their renovation professional went beyond standard practice (e.g., by increasing roof insulation beyond code, or installing a quieter bathroom fan). Professionals should adopt low-cost healthy housing options as a default standard pratice.

Because a substantial proportion of residential construction now consists of renovation, and because this sector continues to grow rapidly, it is important to be informed about Healthy Housing opportunities - including energy efficiency, air quality/occupant health, resource efficiency, environmental responsibility, and affordability - during renovation.☼

Promoting Healthy Housing and Energy Efficiency Approaches in Major Home Renovations: A Case Study Analysis
Prepared for the Research Division, Canada Mortgage and Housing Corporation
by Marbek Resource Consultants

A National Report Card on Energy Efficiency

If we want to have a vibrant economy, protect the environment and reduce our footprint on the earth, we must be more concerned about how we use energy. A key element is energy efficiency. You would think that saving money and improving comfort in buildings would be a "no brainer." Unfortunately, there are many barriers in the marketplace that prevent the most efficient use of energy.

The Canadian Energy Alliance, a not-for-profit organization advocating energy efficiency, has prepared a national report card that reviews government energy efficiency activities. The fact that a national energy efficiency report card issued in May at Canada's energy efficiency conference in Ottawa, received only modest press coverage despite the solid credentials of member companies, illustrates one of the barriers faced. (The Canadian Energy Alliance is not a group of radical tree huggers, but includes some of Canada's elite corporations, including banks, energy utilities, and manufacturing companies. The Alliance is supported by fees and member contributions.)

Summary of recommendations

Many provinces do not have minimum standards for energy efficiency in buildings. In fact, there are regressive steps in Ontario and BC aimed at reducing building standards.

Governments are the largest landlords and tenants, so they have good financial reasons for improving the efficiency of their buildings. They should be leading the way for others, as New Brunswick and the federal government are trying to do. Most other governments, including Ontario's, have missed major opportunities to save taxpayers money.

Apart from the federal government, there is a serious lack of commitment to meeting? the Kyoto climate change targets.

The report card's most disappointing finding is the downward trend in energy efficiency support in almost every jurisdiction in the country. Despite clear benefits, governments have cut budgets, staff and programs. In BC, energy efficiency activities have all but disappeared.

The report card noted that governments can increase public access to information, a key for making informed decisions and can improve accountability and verify results. Improved building codes with increased efficiency requirements are needed. Governments also can increase regulated minimum product standards so that there is a level playing field for all. ☼

National Report Card on Energy Efficiency		
Federal Government	**B+**	High marks for Energy Efficiency Act, building efficiency programs and information and support programs
New Brunswick	**B**	High marks especially for government buildings
Quebec	**B-**	High grades for product standards, progressive policies and for maintaining programs
Nova Scotia	**C+**	Low grades for budget and staff cuts
Manitoba	**C+**	Points for efficiency standards for buildings and products, and regulated demand side management
Newfoundland	**C+**	Overall performance good, but lacks Energy Efficiency Act, significant program cuts
Northwest Territories	**C**	Benefits from federal innitiatives.
Ontario	**C**	High marks for Energy Efficiency Act, but lost marks for major cuts in energy efficiency programs.
Yukon	**C-**	Received marks for energy management programs and outlining detailed recommendations for energy efficiency
Alberta	**D**	Maintained regulated standards for energy efficiency but lost points for major cutback in energy efficiency programs
Prince Edward Island	**D**	Consistent underachiever in most categories. District heating in Charlottetown recognized as a benefit for energy efficiency
Saskatchewan	**D-**	Low marks in all categories. Lack of regulations and energy efficeincy programs combined with cutbacks and difficulty in gathering information led to low grade
British Columbia	**D-**	Low marks due to dismantling of provincial government energy efficiency branch, ceasing programs and dismissing staff

Letter to the Editor

Re: Editor's comments, Solplan Review July 1999

You publish an exceptional publication, but I must take exception to your lumping all construction materials into manufacturers price gouging and unwarranted price increases. The window industry, through strong competition and material and equipment improvements has not had a real price increase in 6 years.

Yes lumber, roofing and drywall have seen "unusual" increases but some industries have not participated.

Keep up the good work.

Bill Scott, V.P. Sales & Marketing
All Weather Windows

The editorial soap box gives one the opportunity to generalize. Obviously, there are exceptions to all cases. I acknowledge that the window industry has seen considerable innovation with minimal price changes, but that is almost the exception. Ed.

You asked us:

Is it possible to have gas appliances in a healthy house?

Natural gas combustion products are relatively clean. The major concern with gas appliances is that their combustion products may spill back into the house. Nitrous oxide gases (which represent a very small quantity of combustion products) are problematic for some. Accordingly, strictly from a health perspective, any open combustion should be avoided. Obviously, properly installed installations are important.

The concern for gas spillage does not mean that gas appliances are to be avoided, rather only those that have the potential to back draft flue gases through their design.

Gas hot water heaters should be sealed combustion, direct vent units. Standard naturally aspirating (open draft) water heaters should be avoided, as there is evidence that they spill combustion gases back into the house quite frequently.

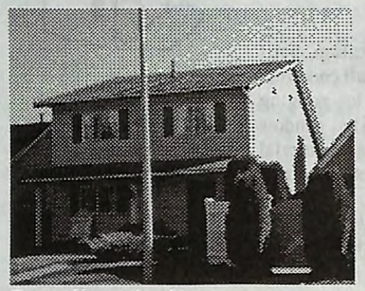
Furnaces should also be sealed combustion units. Many furnaces and hot water tanks are power vented. These use a fan to generate the draft needed. While these are better than natural draft units, but there is still a possibility of some back drafting.

Fireplaces should be sealed, direct vent units. These units isolate combustion from the room.

Gas stoves are more problematic. They have cooking performance characteristics that are desirable but venting the combustion products from the open flame elements totally is not always easy. That is why if there a concern or if someone is sensitive, then gas stoves should be avoided. ☼

Is the R-2000 Home "The Better Built Home"?

A Case Study



Front of house (north)

"R-2000: The Better Built Home" is the name used in program promotion. This line was even used as the title of a series of videos broadcast on educational TV.

Do we have proof that these houses stand up to their name? We know that additional care and attention is given to their construction, and contrary to some old timers' opinions, sound building science is behind the details used. The real proof comes if we can do a forensic review of the construction. Obviously, this is not easy to do. Most home owners do not appreciate someone coming in and cutting up their house to check on the construction details used and how well they perform.

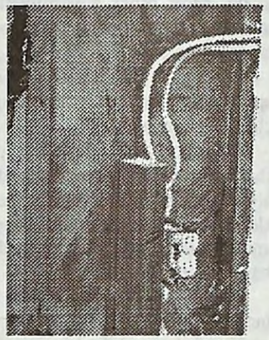
Extensive monitoring has been done on R-2000 homes, especially the homes built in the early days of the program, in the mid 1980s. We know that there have been very few problems, and a high level of customer satisfaction. As for operating performance, R-2000 homes generally meet or exceed expectations.

We have recently been able to take a close look at one of the earliest R-2000 homes built in BC, in 1983 in Richmond. The current owners (the original occupants) were having a simple addition put on, which gave us an opportunity to look at the condition of the house just as the original wall was opened at the start of construction. This gave interesting insights into the performance of the construction.

The house is 1,330 sq.ft., one and half storeys, slab on grade. (Richmond is on the Fraser River delta, so has a water table less than one foot below finished grade). The slab is insulated with 2" rigid Styrofoam under the entire slab, and the slab edge is also insulated on the exterior, with 2" Styrofoam in remarkably good condition.

The exterior walls are 2x6 framing, with 2x3 interior strapping insulated with batt insulation to give a nominal R-28 wall. The roof, which is a vaulted ceiling, has R-20 insulation. Windows are double glazed, clear glass, thermally broken aluminum frames. At time of construction, low-e was still a developing product.

Heating is electric baseboard. Domestic hot water is provided by a standard gas-fired hot water tank (power vented or direct vented sealed combustion water heaters were not available at time of construction.). Ventilation is provided by a heat recovery ventilator - that is still functioning.

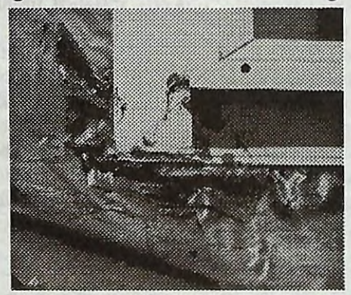


Interior strapped wall. Regular services run between drywall and poly air/vapour barrier.

How has the construction stood up? The polyethylene air and vapour barrier used appeared to be as good as the day it was installed (which was before the availability of UV stabilized poly used today). The sheathing paper was in good condition, showing only slight aging, even though the vinyl siding was applied directly with no rainscreen, although the wall inspected was on the weather side.

One issue often raised, especially in the Vancouver area, is that air sealing and use of polyethylene vapour barriers traps moisture inside the building envelope and accelerates deterioration. Moisture readings in several studs in the original wall showed a moisture content of 11 - 13%, compared with the moisture content of the new framing that was 15 - 20%. (A moisture content of more than 19% creates conditions for the growth of mould and fungus).

It is interesting to note that the owners had anticipated living in the house for about five years. Now, more than 15 years later, they are making changes to their house rather than moving. ☼



Window frame sealing: the "if a little works, more will work better" school of thought. Acoustic caulking on outside of sheating.

R-2000

For information on the R-2000 Program, contact your local program office, or call 1-800-387-2000

Technical Research Committee News

Canadian Home Builders' Association

Information Resources

Unless you are in the market for a right-handed gizmo, you do not pay attention to articles and advertising for right-handed gizmos. It is just like when you buy a new car, you suddenly notice how many similar cars are on the road, because you are sensitized to the product.

For the same reason, you probably do not pay attention to the wealth of information resources available to our industry. However, you need to be aware that most problems you encounter have probably been faced by builders in the past. This information is readily available to you, when you need it. Be aware of the resources, and look at them from time to time - consider it a continuing education program. You might even want to consider setting up a continuing education program for your company and with your associates during the slow season.

If you do encounter a problem, check out these resources first. They may have ready-made answers for you.

Perhaps the most comprehensive housing research information resource is at the ***Canadian Housing Information Centre (CHIC)***. This is CMHC's comprehensive library and resource centre. CMHC publications are also available here - some are free, others are priced. To contact CHIC:

Tel.: 1-800-668-2642
Fax: 613-748-4069
e-mail: *chic@cmhc-schl.gc.ca*
web site: ***www.cmhc-schl.gc.ca***

The National Research Council's Institute for Research in Construction maintains a technical library, and is a resource for technical information.

Canadian Construction Materials Centre (CCMC)

The centre publishes the Registry of Product Evaluations, which contains detailed product evaluations. This document is issued twice a year, and is available free of charge. If you do not need to refer to this document regularly, and want to save a few trees, all the product evaluations are also published on the web, at ***www.nrc.ca/ccmc***

CHBA maintains its own web site, which includes information useful for members, and useful links to other information sources. ***www.chba.ca***

Homeowners' Manual

A while back, we reported the development of a general home owner's manual. That document is now available. The manual is designed to be a guide for homeowner and a service tool for builders. Its format is different from most books and other manuals, because it is sold customized for each home. It is in a three-ring binder, so can be further customized (e.g., by adding equipment warranty cards, product information sheets, appliance manuals, plans, etc.), and allows you to include your own letter of welcome.

Content includes a general overview of basic house components, system description, generic maintenance information and trouble shooting tips. It lets owners know what to expect the first year, and features an annual maintenance calendar checklist.

Because the publication is a binder, it is purchased customized for the address. When you order the manual, you complete a checklist of seventeen multiple-choice items, along with the street address of the house. This identifies the kinds of products or systems the house contains. In this way, irrelevant and potentially confusing material for homeowners is kept to a minimum. Areas covered include site information and services, foundation construction, exterior envelope (roof and walls), interior finishes, heating and ventilation systems, pluming and electrical.

Providing a complete manual to homeowners instead of giving partial information should be a given. The CHIC Homeowners's Manual leaves little excuse not to provide a professional document. BC builders in particular should find this a useful tool, since they now must provide warranty information to purchasers of new homes.

The Homeowners's Manual is available for $39.95 plus shipping and GST from: Canadian Housing Information Centre (CHIC). Tel.: 1-800-668-2642; Fax: 613-748-4069

The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector.

Canadian Home Builders' Association, Suite 500, 150 Laurier Ave. West, Ottawa, Ont. K1P 5J4
Tel: (613) 230-3060
Fax: (613) 232-8214
e-mail: chba@chba.ca

Engineered wood floor systems

Until recently, wood structural materials were sold on a project specific basis with customized engineering plans. Increasingly, these systems are becoming standardized and sold directly through building materials wholesalers. Standardized, generic products can be referenced in codes, and this is the direction the industry as a whole would like to move in.

Yet we continually heard about incorrect application - especially with wood I joists.

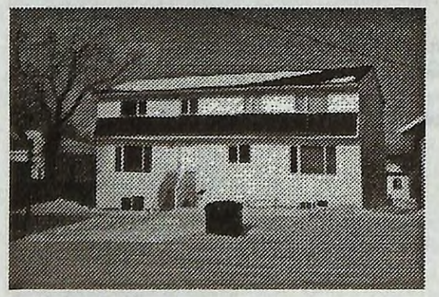
It is important to remember that engineered wood products are different from traditional dimensional lumber. Their use requires special procedures that must be followed to achieve the required properties. Each manufacturer has and distributes installation guidelines. Failure to install the products correctly could lead to serious consequences, not the least being increased exposure to liability for the builder.

Saskatchewan Home Wins Prize for Energy Efficiency

The home of Solplan Review contributor Rob Dumont, in Saskatoon, took top honours in a recent national competition by the Office of Energy Efficiency. Dumont was presented with the award by Ralph Goodale, Minister of Natural Resources Canada, at a ceremony in Ottawa last May.

The home, one of the most energy efficient in the world, combines traditional design with extremely high levels of energy efficiency. It incorporates good zoning within the house, placing living spaces on the south side0, and lesser used rooms such as guest bedrooms, den, and closets on the north side. Energy efficiency features include high levels of insulation (R 80 attic, R 60 walls, R 35 basement floor), an airtight building envelope, high efficiency heat recovery ventilator, passive solar gains, triple glazed, argon filled low-e windows, high efficiency electric lighting, and water conserving plumbing fixtures. The space heating is augmented by an active solar collector system.

North (front) side of house



South (rear) of house

Energy efficiency and low impact environmental features were important features considered at the design stages.

The measured purchased energy of the house has been 47 kWh per square metre of floor area per year, in a climate with 5997 heating degree days (°C). This compares with 143 kWh/m²/year for a similar house in Saskatoon meeting R-2000 targets. (The R-2000 targets are about 50% of that of conventional code construction standards). The home's design heat loss is 5 kW (17,000 Btu/hr) at the design temperature of -34 °C.

Because of the attention given to the design, the high levels of insulation, and energy efficient appliances used indoor, no air conditioning (cooling) is required. This avoided an extra expense of $1500 for air-conditioning equipment.

The house meets all code requirements, and no variances were sought or needed, and it was built by Carroll Homes of Saskatoon. Dumont estimates the incremental cost for the energy efficiency features was 6.5% above conventional construction. The savings in energy and water amount to about $800 compared with a conventional house. The savings are equal to an annual rate of return of 6.2% on the extra investment required. ☼

The challenge has been laid. How many other homes will be built this year meeting, or even approaching, this level of performance? If more homes were built this way, we could say with conviction that we, as an industry, are taking concrete action to deal with climate change issues. The longer this home remains an isolated case, the bigger the challenge, and to harder it will be when we are forced to start building this way.

Insulating Paint - Fact or Fiction?

by George Pinch

Several paints and coatings now on the market are claiming to have insulating properties. The basis for these claims is that the paints have a low emissivity, or are heat reflective, or both. Are such claims fact or fiction?

Heat Transfer

Of the three forms of heat transfer, conduction, convection, and radiation, emissivity has an effect only on radiation. Radiation heat transfer occurs off the surface of a material exposed to a lower temperature. R values, on the other hand, are steady state measurements that average all three forms of heat transfer that occurs through materials.

Emissivity

Emissivity is a physical property that rates a material's ability to radiate heat. The scientific definition is *a ratio that compares the radiating capability of a surface to that of a perfect radiator or 'black body'*. The emissivity of a 'black body' is 1.0. Imperfect radiators or emitters have an emissivity of less than 1.0.

A real life example of differences in emissivity is to compare a wood stove with a domestic pressing iron. Typically, wood stoves are black, and will have an emissivity of close to 1.0, while pressing irons are shiny and bright and will have an emissivity of about 0.05. If you place your hand close to a hot stove, you can feel heat on your hand. If you hold your hand an inch from a very hot iron, you will not feel much heat. This phenomenon could lead you to believe that the shiny chrome plating on the bottom of the iron has a high R value, when, in fact, chromium, like most metals, is a good conductor of heat. Touching either the iron or the stove will result in a painful burn. The explanation lies in emissivity - the inability of a shiny surface to emit infrared (heat) energy.

Low Emissivity vs. R Value

Can a low emissivity surface reduce heat loss? Yes. Can it have an R value? According to the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 1997 Handbook of Fundamentals, yes.

A vertical surface (i.e., a wall) with a surface emittance of 0.9 (typical of concrete, brick or wood) will have an R value of 0.68; if the surface emittance is 0.05, the R value would be 1.7. However, a typical 6 inch thick fiberglass batt has an R value of 20. (The surface R values are in still air, and are based on a surface-to-air temperature difference of 5.5°C, with the surface at 21°C.)

We know of no paint that has an emittance as low as 0.05, and if there is, the emissivity of the surface would increase as it weathered or got dirty.

As the temperature difference increases, radiation heat transfer increases dramatically. On the other hand, heat transfer through bulk insulation (e.g., fiberglass, polystyrene, etc.) tends to be linear, directly proportional to the difference in temperatures. Clearly then, low emissivity coatings will provide the greatest benefits where there are large differences in temperature, such as those encountered in industrial processes. In buildings designed for human occupancy, the difference in temperature between the building surfaces and the surrounding environment is very small. The heat transfer will be small, and any improvement from a low emissivity coating on the building surface will also be small.

Heat Gain

It is well known that some surfaces absorb more heat than others, and that dark colors absorb more heat than light colors. For opaque solid surfaces (zero transmittance), radiant energy that isn't reflected is absorbed. Thus, good reflectors are poor absorbers. Surfaces that are good reflectors in the visible spectrum MAY also be good reflectors in the infrared spectrum, thus reducing heat gain from a high temperature heat source (e.g., the sun, a blast furnace or high pressure steam lines). Paints and coatings that resist high temperature (i.e., do not discolor and darken) could be very effective at blocking unwanted heat and reducing heat gains.

Results of Product Testing

Manufacturers of low emissivity coatings or "insulating paint" have had their products tested by highly respected testing agencies, but none of the test reports published have been for standard ASTM tests. ASTM has two accepted test procedures for determining the thermal resistance of materials. The manufacturers of low emissivity coatings appear to have invented their own test procedures, which provide the favorable results they want. If the products really have an R value as claimed, manufacturers should jump at the opportunity to prove it to the world by testing to recognized standards. Not following the accepted testing standards casts doubt on the R value claims made for these products. ☼

Comfort Benefits of High Performance Windows

We tend to focus on better windows because of their reduced energy consumption - which is a quantitative factor. However, we should also consider a more significant, qualitative aspect–improved comfort.

When it is cold outside, a window's interior surface temperature drops. The more efficient the window, the warmer the interior surface temperature will be. New high performance windows with multiple low-e coatings and gas fills can have surface temperatures that are close to room temperatures.

Using high performance low-e windows is better than drawing blinds and relying on heating systems to solve thermal comfort problems. Mechanical systems often create non-uniform interior conditions, only partially relieving thermal discomfort. They also break down and may be unavailable when most needed.

A warm window surface temperature is important because comfort depends on radiant heat transfer between people and their surroundings. Warm bodies always lose heat to colder surfaces. We lose heat when our body "sees" cold surfaces and we feel uncomfortable. (The reason night temperature can fall so low on a clear night even in the middle of summer is that the earth loses heat into space). This is true even when only part of our body is exposed to a cold surface, as, for example, when sitting around a campfire on a cold night.

Another reason for winter discomfort is that the cold surfaces of an inefficient window produce convective currents or drafts in a room. Both radiant heat loss and convective currents from cold windows make us turn up thermostats.

Studies at the Lawrence Berkeley National Laboratory suggest that only low-e argon gas filled units can maintain an inside glass surface temperature above 52° F, considered necessary to maintain comfort conditions. ☼

US Energy Star Windows and Canadian ER (Energy Ratings) Compared

The US ***Energy Star*** window program is a labelling program. Criteria are based on a minimum U-value and Solar Heat Gain Coefficient values for three climatic zones in the US. In the Northern U.S., the Energy Star criteria is a U-value of 0.35 or lower with no requirement for Solar Heat Gain Coefficient (SHGC). (U=0.35 is R2.85)

How does this compare with the Canadian ER rating? The Canadian ***Energy Rating*** (ER) formula looks at the whole window. The ER considers more than just the heat loss or U value. It takes into account solar gains, transmission loss, and infiltration loss. A large range of Canadian window products meet the Northern Energy Star window U-factor. However, many windows meeting the Energy Star window requirement do not meet the ER target of -13 for operable windows and 0 for fixed windows, the requirements in the Model National Energy Code for Houses in many regions of the country.

Windows with ER -14 to -23 (operating windows) and -1 to -19 for fixed windows meet the US Energy Star criteria. ☼

Changes to the NBC 1995 are now available for download (PDF format) from IRC's Web site: *http://codes.nrc.ca/codes/home_E.shtml*

This update package contains information identical to that in the original Errata and Revisions package issued to all users in July 1998. Fax: 1-613-952-7673
E-mail: *Irc.Client-Services@nrc.ca*

Thought to consider:

The environmental choice we make today will echo into the future. When we find sustainable ways to live, the environmental crisis will fade away.

Activities are sustainable when they:
1. use materials in continuous cycles
2. use continuously reliable sources of energy
3. come mainly from the potentials of being human

Activities are not sustainable when they:
4. require continual inputs of non-renewable resources
5. use renewable resources faster than their rate of renewal
6. cause cumulative degradation of the environment
7. require resources in quantities that could never be available for people everywhere
8. lead to the extinction of other life forms.

It's worth considering why we seem to be in the social and environmental mess we're in today.

In the 19th and 20th centuries as our technological prowess emerged, three major forces altered our thinking. The first was a sense of control and power that allowed us to do anything we wanted. Electric power, air conditioning, elevators gave us a sense that we could build anything, anywhere, anyhow because we could control what was inside. The second was telecommunications, which eliminated the need for proximity to afford effective communication. The Third was our automobile passion, which has shifted our focus from planning for people to planning for cars.... this has had the net effect of destroying public transportation systems, isolating communities and de-personalizing our lives. Add to these factors, a feeling that all resources are unlimited and you have the recipe for our current crisis; a crisis where people and the environment have become enemies.

NRC·CNRC

Protecting Masonry from Water Run-Off

by A.H.P. Maurenbrecher

It has been said many times before, yet it is advice that needs to be repeated: concentrated sources of water run-off onto masonry surfaces should be kept to a minimum. Only then can you realize the long-term durability and low maintenance for which masonry is known. To do this, however, requires attention to such important exterior design details as projections and drips – roof overhangs, copings, window sills and gutters – which protect vertical surfaces. (Figure 1 shows a coping.)

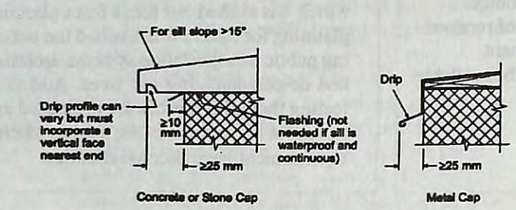


Figure 1. Proper design of copings or caps

Water can spoil the looks of a wall through staining, efflorescence and biological growth, although it would perhaps be considered annoying rather than alarming. After all, efflorescence is usually just a deposit of white salts left on the surface of masonry when the water in which it was dissolved evaporates (see Figure 2). And staining may have occurred when water carrying dirt runs onto the face of the masonry. For example, water running off fittings and decorative items projecting beyond the surface of the wall can cause staining. But water can also lead to material damage: not only accelerated corrosion of metal components in the wall but also spalling (for example, frost damage). Keeping excess water off the masonry is one of the best safeguards. Design objectives should therefore be to avoid concentrated flows of water and to reduce the time of wetness. The longer an area remains wet, the greater the chance of its becoming saturated.

Much damage can be avoided by using:

- copings that extend beyond the face of the wall;
- waterproof caps and flashings, which divert water from the masonry;
- a projecting metal flashing between a sill or cap and the wall; or
- masonry with a known high frost resistance.

Figure 2. Effloresence on an apartment building caused by a coping that allows water to drain onto the wall

Copings or flashings that project at least 25 mm beyond the face of the wall have proven to be effective. Concrete or stone copings must have a drip groove to stop water from running back under the overhang, while metal copings must have a drip edge (see Figure 1).

Windows and Sills

Detailing is critical at windows. Sills should be sloping downward and stick out so that water dripping from them does not hit the wall. Here too a drip or groove along the underside of the sill may be necessary. The sides of the sill should be raised to stop water from running off the ends. Where possible, sills should be made in one piece without any joints to avoid the sort of problem shown in Figure 3. Alternatively a projecting waterproof flashing should be inserted under the sill.

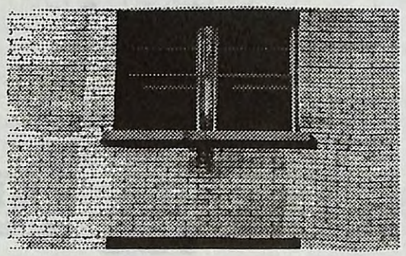


Figure 3. Staining beneath junction in window sill

This article is based on Construction Technology Update No. 23, part of a technical subscription series published by NRC's Institute for Research in Construction. Dr. A.H. Paul Maurenbrecher is a research officer in the Institute's Building Envelope and Structure Program.

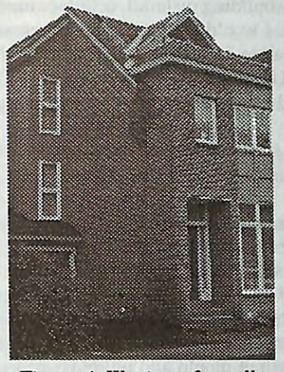


Figure 4. Wetting of a wall from roof run-off

Roof Details

Water run-off from pitched roofs is considerable, and therefore it must be shed well away from the wall or be collected by gutters. With complicated roof forms, this may not always be successful. The house shown in Figure 4 has some of its roof run-off funnelled to one location that does not effectively shed water. The water is wetting the brick near the top of the wall and at ground level (the latter from splashing). Such problems must be promptly corrected, in this case by installing a gutter and downspout.

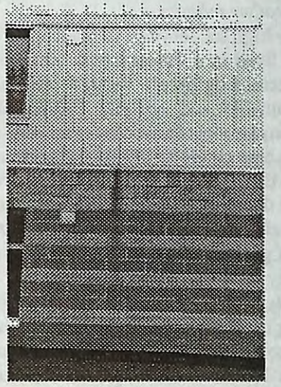


Figure 5. Staining below junction in flashing set back from the wall

Siding

Concrete and aluminum or vinyl siding above masonry must have a flashing at the intersection to shed water away from the masonry. Figure 5 shows a building with aluminum siding. The siding has drips at every storey to break the flow of water down the wall. But above the masonry of the ground storey, the flashing does not project beyond the masonry. Here much of the water runs along the flashing until it hits a junction and then drains downward, leading to staining.

Good design lessons can be learned by closely observing the exterior surfaces of buildings. It is instructive to look at building details to see how they affect the flow of water on the surface and how water can influence surface appearance and deterioration. It soon becomes obvious how mistakes continue to be made that can jeopardize the look and durability of masonry. Careful attention to simple details – which may seem minor in relation to the technological breakthroughs occurring in construction these days – will reduce the amount of water getting onto the masonry and hence preserve the attractiveness and service life of this popular construction material. ☼

Energy Answers

Rob Dumont

In your last column, you stated that the energy payback on the extra cellulose attic insulation you installed in your house was about six years. I read recently that the cellulose industry claims that the embodied energy of cellulose is roughly 1/20 to 1/40 of the embodied energy of fiberglass. (See the Cellulose Insulation Manufacturers' Association web site at www.cellulose.org.*) If these numbers are correct, then the energy payback period on that extra insulation in your house (increasing your attic insulation from R35 to R80) is actually less than a year. Do you agree?*

Yes. Cellulose insulation is definitely a "greener" product than most of its competitors. Made from recycled newsprint with an added fire retardant, cellulose is much less energy intensive than other types of insulation such as those that have been produced by melting glass or rock. Cellulose is also much less energy intensive than plastic insulation such as polystyrene and polyurethane that are made from petrochemicals. Older cellulose insulation was made using a hammer mill; the newer process uses an air-based technique to "explode" the paper and separate the fibers. The newer cellulose has a lower density for the same insulating value, and thus is even more resource efficient than the older product. And, as I mentioned in an earlier column, there is a very large source of used paper available in Canada, with only about 35% of all newspaper being recycled and the rest land filled.

I called one of the cellulose manufacturers to try to get the figures on the energy embodied in cellulose insulation. They referred me to the U.S. web site mentioned above. I then tried to get corroborating information from the Athena Sustainable Materials Institute. They informed me that I could not get the information on cellulose and other insulation materials unless my company bought a membership in their organization. So much for the free flow of scientific information!

One of the problems that the cellulose insulation industry has had to deal with is the fear that the insulation is carbon-based and will burn. Most people seem to forget that there are all kinds of combustible materials used in buildings–carpets, vinyl flooring, furniture, cabinets, doors, etc. And in low-rise residential construction (less than about four storeys), the framing members are usually wood.

I have no problems with using cellulose in my own house; I also can recommend it for others. As with any building material, cellulose must be used sensibly. I would definitely not recommend placing cellulose insulation, or any other insulation material for that matter, directly on top of a ceiling mounted recessed light fixture such as a pot light.

Do you have any comments about the leaky condominiums in the Vancouver area?

Here are a few thoughts from someone who once lived for 22 years in the lower rainland.

1. Design counts.

Wood rots if it gets wet and cannot dry in a reasonable amount of time. Any porous construction material that accumulates water will support the growth of mould and mildew.

The leaky condos that are plaguing the lower rainland of B.C. were built using proven materials like stucco, building paper, OSB sheathing, and wood studs. The reason they are leaking and rotting is that the designs were poor and the installations were poor. If you slope patios and balconies so that water continually runs against the walls of the building, if you layer the building paper so that the water runs into the walls, if you improperly flash windows and doors, if you use stucco as a waterproofing material, your buildings will have problems. The problem was not with the materials, but with design and installation. No building material on its own can solve problems of poor design.

2. Weather matters.

In my high school years in Vancouver I learned that we lived in a "West Coast Marine" climate characterized by ample rainfall, relatively poor winter sunshine and cool temperatures; all of these conditions are ideal for wood rot and mould growth.

But, some condo building designers are much smarter than school children. They "know" that weather does not matter. The architects and designers all read the same glossy magazines and strive to get their buildings looking just like the ones they see there. In this century the "international style" has reigned supreme: thus a new building in Arizona will look like one in Zimbabwe. A condo in Burnaby will look like one in San Diego or Tucson. A building built in the rain forest will look just like one built for the desert.

And wet wood rots.

3. Almost anyone can be a contractor.

A cell phone and a pickup truck do not a good contractor make. In times of strong demand, all sorts of fly-by-nighters will enter the market.

The marketplace in B.C. had no sense of "caveat emptor." In a market where housing prices were skyrocketing, there was near-panic buying. To use a prairie metaphor, instead of buying number one oats, people were buying oats that had already passed through the horse.

To drive an automobile, one needs at least to pass a rudimentary examination and a road test. Construction has almost no entrance qualifications.

(This has now changed. New licensing requirements have come into effect that places more direct responsibility on indidual contractors. Mandatory third party insurance coverage and contractor licensing is now a condition for issuance of building permits. Ed.)

4. Alternative materials are not the solution

One solution being touted now is that we should not build multi-storey buildings out of wood frame but should use, steel, concrete, and exterior gypsum board instead. The problem with this approach is that leaky buildings made of steel and concrete will also be (and are now being) constructed unless good design and installation procedures are used.

Some years ago I visited Oslo, Norway, where I saw a wood-framed and sided church built over 700 years ago. A wooden building can last indefinitely if properly designed and maintained. ☼

Coming Events

Oct. 29, 1999
Housing Issues Conference (CHBA-BC)
Vancouver, BC
Tel: 604-432-7112
Fax: 604-432-9038
www.chbabc.org

Jan 19-20, 2000
Ontario Building & Renovation Forum
Toronto, ON
Tel: 416-447-0077
Fax: 416-443-9982

Jan. 23-23, 2000
Interior Design Show
Toronto, ON
Tel: 416-599-3222
Fax: 416-599-3224
www.interiordesignshow.com

April 3-8, 2000
Affordable Comfort Conference
Columbus, Ohio
Tel: 800-344-4866
Fax. 724-223-7754

Apr 7-8, 2000
CIPHEX West 2000
(Plumbing & Heating Show)
Calgary, AB
Tel: 416-695-0447
Fax: 416-695-0450
www.ciph.com/ciphex/

May 11-13, 2000
Interbuild 2000
Housing and Construction Show
Toronto, ON
Tel: 888-922-3600 (toll free)
Fax: 780-413-6224
e-mail: info@interbuild2000.com